Flow characteristics at a forested site with wind turbines

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At a 140m tall mast in a forest in South-Eastern Sweden, a measurement campaign with sonic anemometers as well as remote-sensing wind instruments has been running since November 2010. As is the case with many wind energy sites, the mast is located in a clearing. Two turbines with hub heights at 80 and 100m respectively are located approximately 200m from the mast. We present an overview of the flow characteristics at the site including the influence from the turbine wakes and the clearing. The overview is limited to near-neutral conditions. In addition, a sector is selected for which flow characteristics for all stratifications are shown. These measurements are influenced from several different regimes in the atmospheric boundary layer (ABL); (1) the roughness sublayer close to the forest surface where length scale are increased compared to surface layer scaling, (2) a surface layer, where the momentum flux is near-constant with height and (3) an Ekman layer where the length scale is decreased due to the influence of the ABL height. Surprisingly, the wind direction data indicates that the ABL height is generally low at the site, since there is a systematic and significant wind direction change with increasing height.